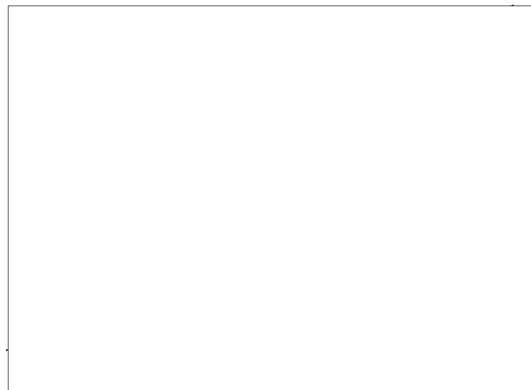
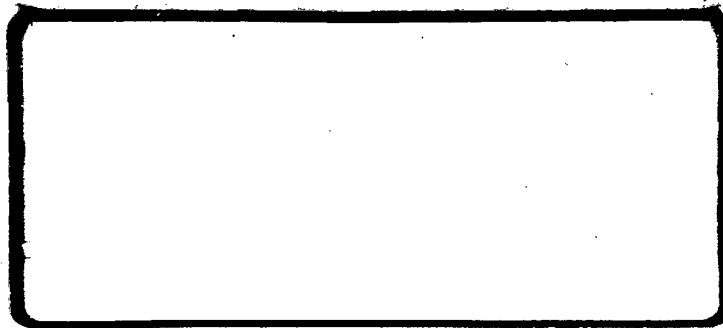


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**STATUS REPORT**

for Period

1 February through 28 February 1969

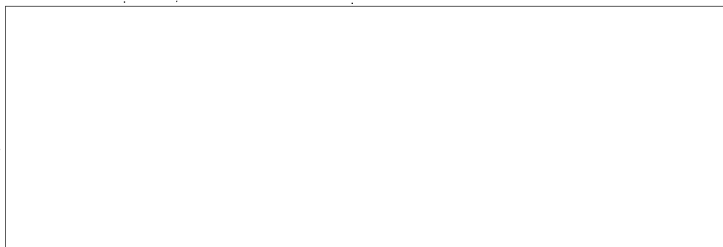
Submitted under Contract to

U. S. Government

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File No. 11038


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This document is presented as the Monthly  
Status Report under Contract to the U.S.

Government, 

STAT

The report period represented herein covers the  
period 1 February through 28 February 1969.



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### PROGRESS SUMMARY

Scheduled percentage of completion - 47.5%

Actual percentage this date - 45.8%

This reporting period was highlighted by a substantial amount of progress in several critical areas - Optics, Test Programs, Facilities, Instrumentation, and Computer Programming. Each of these items is covered in detail within their individual task headings.

A development of major importance is the change in percentages of completion and scheduled completion of Tasks 16, 17 and 18 - Optics. This change is the result of re-scheduling these tasks during the month of January to conform with the subcontractor's planning changes which were reported during that month.

Overall program progress is entirely satisfactory, with only the normal number of "course corrections" required. Sub-system assembly is proceeding on schedule, and it is anticipated that testing of the subsystems will begin during the next report period.

In summary, management is generally pleased with the program position at this writing.

Task 01

Statements of Work, Specifications, Report  
Preparation

Scheduled percentage of completion 50%

Actual percentage this date 50%

There have been no significant developments  
in this task. Normal reporting cycles have been observed,  
and new specifications will be submitted as they are prepared.

Task 02	Scheduling and Planning	
	Scheduled percentage of completion	50%
	Actual percentage this date	50%

New schedules for Tasks 16, 17, 18 and 24 have been prepared. The predicted percentage of completion and the actual percentage of completion have been recomputed on the basis of the new schedules for the months of January and February 1969.

The schedule of Deliverable Items for the Stereocomparator has been reviewed with respect to changes in the delivery date for Tasks 16, 17 and 18 - Optics, and for Task 24 - Image Analysis System.

The new schedule requires the computer program to be completed by April 6, 1970, and all drafts of the instruction manuals, including the spare parts list to be completed by November 24, 1969. The acceptance test plan draft would be delivered to the customer by February 22, 1970, and the as-built drawings would be delivered by July 31, 1970. The contract termination date would be July 31, 1970.

In scheduling these changes, the computer programming instruction manual completion has been changed to set the date for issuing the manual after it has been tested on the Stereocomparator at  As originally scheduled, the manual and the computer programming tape would be provided prior to test. This would not be realistic in that developments during testing and checkout will inevitably cause changes in the computer program. With the revised schedule, the manuals as issued to the customer will include the fully operable information.

STAT

Further, the contract completion date has been set after the delivery of the Stereocomparator. Under the new schedule, the various instruction manuals will reflect information obtained during the assembly and testing of the operating hardware. Delivery of the material as scheduled originally would have resulted in the manuals lacking the most up-to-date and verified material.

Task 03                      Test and Inspection Procedures

Scheduled percentage of completion                      29%

Actual percentage this date                                      28%

This task is proceeding as originally planned with systems test procedures being prepared as "fall-out" from the subsystems tests.

Present effort is being directed toward the development and implementation of system simulation tests using the computer programs which are being produced by

(Task 43).

STAT

Task 04

Management

Scheduled percentage of completion 50%

Actual percentage this date 50%

No major difficulties have been experienced during this reporting period, and no difficulties are anticipated.

The film cooling breadboard (Task 14) has been fabricated, and the results of air volume and temperature tests being evaluated.

Other tests are being conducted as reported under specific task headings.

Task 05 Meetings

Scheduled percentage of completion 50%

Actual percentage of completion 50%

There were no meetings scheduled for this reporting period.

The next formal progress meeting with the customer will be held at  during the second week of March.

STAT

Task 06      Facilities

Scheduled percentage of completion      70%

Actual percentage this date      68%

The advent of several days of clear weather has allowed the electrical and air conditioning subcontractors to perform most of their outside activities during this report period.

All air conditioning ductwork and related equipment to the building has been installed, and is ready to be insulated.

The electrical connections to the motors and controls are being made, and the temperature control instrumentation is being installed.

Present schedules call for installation of the in-room ductwork during the week of March 14.

Task 07

Main Frame and Structural Elements

Scheduled percentage of completion 98%

Actual percentage of completion 93%

No additional work was scheduled for this task  
for the month of February.

As reported previously, this task is virtually  
complete.

Task 08

Skin

Scheduled percentage of completion 35%

Actual percentage this date 30%

No additional skin fabrication was scheduled  
for the month of February.

Fabrication of skin coverings for both the right  
and left stages will be scheduled later in the program to coincide  
with overall assembly of the Stereocomparator.

Task 09

Granite and Ways Assembly for Stages

Scheduled percentage of completion 98%

Actual percentage this date 87%

The two granite stages on which the film will be mounted were drilled and tapped, and have been mounted on to the base granite sections.

The four interferometer supports were received from the vendor during the month of February. The necessary holes and brass plugs are scheduled to be drilled and tapped by the  shop during the month of March.

STAT

Delivery of the two laser supports has been rescheduled by the vendor, and we anticipate receiving these the first week in March.

Task 10      Air Bearings

Scheduled percentage of completion      62%

Actual percentage this date      75%

The air bearings required to guide and support  
the right and left hand stages were installed during the month  
of February.

Task 11

Stage Drives

Scheduled percentage of completion 60%

Actual percentage this date 55%

Work is now in process installing the stage drives required to move both the left and right stages.

It is anticipated that this installation will be completed during the month of March.

**Task 12      Film Drive and Transport System**

**Scheduled percentage of completion      50%**

**Actual completion this date      62%**

**As reported previously, the film drive and transport system is complete with the exception of modifications necessary to control the vacuum clamping and air lift-off systems.**

**These modifications are being done by the  shop and completion is anticipated by the end of March.**

**STAT**

Task 13. Film Platen and Film Clamping

Scheduled percentage of completion 38%

Actual percentage this date 39%

A breadboard model of the film clamping system is being fabricated by the  shop. This unit will assist in resolving difficulties which we have experienced with the film clamping operation.

STAT

The problem to be overcome is failure of the film to position itself for vacuum clamping. Certain old and thick rolls of film are permanently curled away from the platen. This causes so great a vacuum leak that the clamping process does not self-initiate. A breadboard unit to provide automatic auxiliary clamping of the film is under construction.

Upon completion of the mechanical portion of this prototype, some changes will be made in the film control circuitry which provides the control system for the revised vacuum clamping and lift-off apparatus.

It is anticipated that the prototype will be in operation during the month of March.

Task 14      Film Cooling

Scheduled percentage of completion      28%

Actual percentage this date      32%

A prototype film cooling and lift-off device  
(see Task 13) has been fabricated by the  shop, and we are  
now in the process of testing air flows that will be required to  
cool the film and provide the film lift-off necessary when slewing.

STAT

Both the volume and temperature of the air required  
will be determined for the final film cooling assembly.

Tasks 16, 17  
and 18

Viewing Optics, Viewing Illumination and  
Reticle Projector and Illumination

Scheduled percentage of completion 55%

Actual percentage this date 55%

A monitoring trip was made to [ ] during the  
month of February.

STAT

A copy of the trip report is included as Appendix I.

As a result of schedule information obtained during  
December 1968 and confirmed during February 1969, the schedule of  
work at [ ] has been revised. There is no change in the delivery  
of the optical system over that predicted in the January 1969 report.

STAT

Revising the schedule changes the base for computation  
of the percent completion predicted. On the basis of the presently  
existing schedule, the values for schedule completion and actual  
completion for January 1969 would be 44%. The equivalent values  
for February 1969 are 55%. There has been no slippage of the [ ]  
schedule during the period of December 1968 and January/February 1969.

STAT

Task 20      General Platen Illumination

Scheduled percentage of completion      55%

Actual percentage this date      41%

As reported previously, this task is virtually complete. No additional work was scheduled for the month of February.

Task 21            Optical Bridge and Supports

Scheduled percentage of completion            90%

Actual percentage this date                      90%

No work was scheduled on this task for the  
month of February.

As reported previously, the bridge and supports  
have been sent to the optical subcontractor for installation of  
the optics.

Task 22

Interferometer Assembly

Scheduled percentage of completion 58%

Actual percentage this date 57%

As reported previously, the interferometer assembly is ready for installation.

Upon receipt of the granite laser supports, this assembly will be installed, and testing of the interferometer assembly with the stage drives will begin.

Preliminary tests of the interferometer assembly as a unit have been satisfactory.

Task 23            Optics Drive Assembly

Scheduled percentage of completion            42%

Actual percentage this date                    38%

The vendor supplying the two remaining chassis necessary to interface the optics drive assembly with the optics has rescheduled delivery for the month of March.

We are presently undergoing a concerted effort to perform an electromechanical loop simulation in order to get the compensation networks for the servo determined and built into the equipment. (See Breadboards and Test Services, Task 42.)

Task 24

Image Analysis System

Scheduled percentage of completion 34%

Actual percentage this date 45%

[redacted] for approval, three  
photographic slides to be used as test imagery. These were  
approved by [redacted] with a suggested change in field, and returned  
to [redacted]

STAT

STAT

STAT

A quantity of paint was sent to [redacted] this month  
for painting the [redacted] furnished chassis.

STAT

STAT

A copy of [redacted] progress report for the month of  
January is included herewith as Appendix II.

STAT

Task 26                      Digitizing Logic Subassembly

Scheduled percentage of completion                      85%

Actual percentage this date                                      84%

As reported previously, this task is virtually complete. No additional work was scheduled for the month of February..

Task 27

Metric Readout

Scheduled percentage of completion 94%

Actual percentage this date 92%

As reported previously, this task is virtually complete.

No additional work was scheduled for the month of February.

Task 28      Output Logic and Interfaces

Scheduled percentage of completion      86%

Actual percentage this date      70%

In view of the fact that the computer program is now available, review of the internal computer interface circuitry has taken place in order to insure that the computer program and circuit interface are compatible.

It was found that some revisions or corrections in either the program or the circuitry were necessary. These corrections are in process. However, further review of the circuitry was needed in all units interfacing with the computer (internal computer interface). As a result, minor modifications had to be performed in the A/D and D/A converter, stage position unit, stage drive unit and output interface unit.

## Task 29

## Cabling

Scheduled percentage of completion 90%

Actual percentage this date 90%

The percent progress of the cabling required to inter-connect the various electrical and electronic elements being assembled in the  shop is as follows:

STAT

Cabinet #1 (Stage drives, film drive and transport system)	100%
Cabinet #2 (Optics drive, interface with Image Analysis System)	100%
Cabinet #3 (Metric readout, output logic and interfaces)	89%
Electrical arrangement (floor inter-connection of all cables)	89%
Control Console	97%
Display Panel	55%
Optical Bridge	50%
Stage Assembly	73%

Task 30      Control Console and Chair

Scheduled percentage of completion      72%

Actual percentage of completion      67%

The wiring of the control console is in the final stages of assembly, and we anticipate that testing of this wiring will begin during the month of March.

As reported previously, the mechanical portion of the control console is complete.

P

Task 32            Computer

Scheduled percentage of completion            95%

Actual percentage this date                    95%

As reported previously, the DDP 516 computer has been available at the [ ] facilities since September 1968, and has been used by the computer programming subcontractor for the development and preparation of the computer program.

STAT

The [ ] shop is scheduled to clean, disassemble and relocate the computer in the Clean Room during the month of March.

STAT

Task 33      Electronic Racks and Control Cabinets

Scheduled percentage of completion      78%

Actual percentage this date      84%

During the month of February, slides were fabricated for the logic chassis by the  shop. Minor rework was also done on the chassis mounting rails in order to "true" up the placement of the chassis in the cabinets.

STAT

We anticipate installing the chassis in the cabinets during the month of March.

**Task 34      Utilities, Vacuum and Air Systems**

**Scheduled percentage of completion      42%**

**Actual percentage this date      35%**

Because of the high priority given to the preparation of the Clean Room, we have found it necessary to re-schedule the installation of the mechanical components comprising the utilities assembly for the month of March.

Both the mechanical and electronic assemblies have been completed and are ready for installation.

Task 35                      Vibration Absorption and Leveling

Scheduled percentage of completion                      90%

Actual percentage this date                                      85%

A representative from [ ] the vendor  
supplying the vibration control system, visited the [ ] facilities  
during February and installed modified vibration sensing elements  
on to the Stereocomparator. However, the vendor requested that  
all of the components be installed on the leveling units before the  
"final tune" of the system be made.

STAT

STAT

We are therefore scheduling the final acceptance  
testing of this equipment later on in the program.

Task 36 Overall Assembly

Scheduled percentage of completion 22%

Actual percentage this date 15%

During the month of February, the granite stages were mounted on to the granite bases (see Task 9).

Upon the completion of the Clean Room which is scheduled for the middle of March, additional subassemblies will be installed on the Stereocomparator.

Task 37      Radio Frequency Noise Suppression

Scheduled percentage of completion      0%

Actual percentage this date      0%

No work was scheduled on this task during the  
month of February.

Task 38 Environmental Control

Scheduled percentage of completion 50%

Actual percentage this date 48%

The special air conditioning requirements associated with air which is directly in contact with the film is presently being studied. Some time ago it was pointed out that the dimensional stability of the film is more critical with respect to relative humidity change than it is for temperature change.

New requirements for controlled air volume are being prepared based on experiments which will provide the cubic feet per minute necessary for the special environmental control subsystem.

It has been suggested by the customer that the test of this subsystem (which is a package unit) might best be done at  rather than waiting until several months later after the Stereocomparator has been installed at  and then performing the tests. STAT

This suggestion is being evaluated, and if the equipment can be used effectively at  it would provide performance information early enough in the program to accommodate any revisions found necessary. STAT

At the request of the customer, a meeting is planned during March when the final drawings for the arrangement of the site environmental control will be discussed with the customer site preparation consultant and engineers.

Task 39

Reliability Analysis

Scheduled percentage of completion 0%

Actual percentage this date 0%

No work was scheduled on this task for the month of February.

Task 40      Installation

Scheduled percentage of completion      6%

Actual percentage this date      8%

As mentioned under Task 38 - Environmental Control,  
a meeting is scheduled at the customer's site between the customer  
representatives, including the air conditioning and site preparation  
consultant and

STAT

This meeting is for the purpose of reviewing the  
final site preparation drawings.

Task 42      Breadboards and Test Devices

Scheduled percentage of completion      23%

Actual percentage this date      18%

We are making an electromechanical breadboard of all of the computer controlled optical drives, using dial indicators as position readouts. This breadboard will be connected to actual servo mechanical and electronic hardware in order to make certain that the servo equipment performs properly.

This will also serve as a means of testing the real-time computer program to make certain that all of the proper interface requirements between the computer program, the digital logic and the analog control circuitry have been met.

This work is in progress and it is planned to begin preliminary testing of the system by the first of April.

Task 43                      Computer Programming and Services

Scheduled percentage of completion                      40%

Actual percentage this date                                      55%

   [ ] personnel are continuing to  
develop the computer program for the Stereocomparator, using  
the computer installed at the [ ] facilities.

STAT

STAT

Enclosed with this report as Appendix III is

[ ] progress report for the month of January.

STAT

**Task 44      Preacceptance Test in Fabrication Plant**

**Scheduled percentage of completion      0%**

**Actual percentage this date      0%**

**No work was scheduled for this task during the  
month of February.**

**Task 45            Acceptance Test in Fabrication Plant**

**Scheduled percentage of completion            0%**

**Actual percentage this date                    0%**

**No work was scheduled for this task during  
the month of February.**

Task 46                      Acceptance Test after Installation

Scheduled percentage of completion                      0%

Actual percentage this date                                      0%

No work was scheduled for this task during  
the month of February.

Task 47                      Instruction Manual and Drawing Submittal

Scheduled percentage of completion                      12%

Percentage completed this date                                      10%

The Stereocomparator design drawings continue to be revised to cover the "as built" status for the various subassemblies.

Work is also continuing on the preparation of the Operator's Manual.

Task 48            Spare Parts List

Scheduled percentage of completion            6%

Actual percentage this date                      15%

We are continuing to compile the recommended spares for the Stereocomparator. The mechanical portion of the Spare Parts List has been completed, and we are now in the process of detailing the recommended spares for the electronic parts.

Task 49      Operator Training

Scheduled percentage of completion      2%

Actual percentage this date      40%

Work continues on the preparation of the Operator Training Manual to be used in the actual training of customer personnel who will be operating the Stereocomparator.

The mathematical review and the first section relating to aerial photography applications have been completed.

APP. I

## TRIP REPORT

Company Contacted:

STAT

Contacted by:

Date:

Week of February 10, 1969

Persons Contacted:

STAT

### DRAWING REVIEW

had completed many of their subassembly drawings STAT  
which related to an interface with the  detailed drawings. The drawings STAT  
were reviewed on an item-by-item basis, and there were no major impasses  
discovered.

There were many detail adjustments and minor re-arrangements  
which will be accommodated by changes either by  For STAT  
example, the anamorph potentiometers were too long to fit the  STAT  
interface.  will provide a different mounting arrangement with an STAT  
extended (5") shaft and an intermediate bearing.

All items and questions were disposed of.

### SLIPRINGS

The slipring assemblies for the anamorph system are being  
supplied by  but will have to be installed by  on their rotating STAT  
anamorph subassembly. The sliprings have been received at  and are STAT  
presently being tested. As soon as possible, they will be sent to  STAT

Trip Report -   
Continued

STAT

so that they may be fitted to the Sopelem assembly. Photographs of the  
sliprings were given to  showing the arrangement of the mounting hoSTAT

Sets of taps, drills and bolts are being sent airmail to  STAT  
so that proper preparation can be made to accommodate to the non-metric  
threaded parts.

#### EYEPIECE MARK

A question had been asked by our customer as to whether or  
not there was an eyepiece setting showing an optical neutral for the eyepiece  
focussing adjustment. This neutral mark would assist the customer in  
setting up for photographic or similar purposes where a return to a preset  
optical condition might be required.

is providing a neutral mark so that the eyepieces can be STAT  
adjusted to the optical neutral.

#### CONSOLE EYEPIECE INTERFACE

There were a number of problems in connection with the interface  
between the eyepiece switching block, provided by  and the  STAT  
console.

To help interpret the drawings,  has asked that some STAT  
photographs be sent them showing the arrangement of the  console STAT  
interface.

Polaroid photographs of the parts in question are being sent to  
 immediately. STAT

#### EYE SHIELDS AND HEADREST

Some time ago, [ ] had agreed to furnish information so STAT  
that [ ] could provide the stray light shields around the eyepieces and STAT  
the rubber headrest roll above the eyepieces.

[ ] has now made the arrangement drawings showing the STAT  
requirements that [ ] must meet in order to properly interface with the STAT  
[ ] eyepiece switching block. [ ] is detailing from these drawings STAT  
for the headrest and stray light shield edge guards. These parts will be  
supplied and fitted to the control console by [ ] STAT

#### PAINT COLOR MATCHING

A sample of grey paint was carried to [ ] in liquid form, STAT  
and they will match this color for the painting required on the non-light  
path associated portions of the optical bridge.

[ ] was directed that all parts associated with the light path STAT  
on either the interior of the optical bridge or its exterior must be colored  
flat black by [ ] Many such parts will not require actual painting STAT  
since they will be either oxidized black finish or anodized black finish.

#### TEST FIXTURE STAGE

[ ] had designed an X and Y moveable stage for holding STAT  
test targets in their test fixture. Some of the tests envisioned a rotation  
mode and therefore this stage as designed by [ ] would not be satis- STAT  
factory.

It was suggested to [ ] that they might more economically STAT  
purchase a pair of commercially available stages from the [ ] STAT

in Germany. These stages had all the required motions and the performance characteristics required for the testing schedule.

Descriptive advertising and prices were obtained from the American representative of [ ] and were given to [ ] for their information. STAT

[ ] was told that vacuum holddown for the films and plates during testing would be required. This had been found necessary at [ ] since the film resolution targets buckled under the warmth during viewing unless they were held down by a vacuum. STAT

#### OPTICAL BRIDGE INSTALLATION ACCURACY

The optical bridge parts and the assembly tooling for them had been received at [ ] some time before, and had been found to be undamaged during the shipment from [ ] STAT

[ ] placed the optical bridge parts on an appropriate tooling flat and determined that they would have to hand-scrape the bearing surfaces to provide closer tolerances, both for mounting the [ ] optical parts and for mounting the optical bridge to the [ ] test fixture. This degree of preciseness had not been contemplated by [ ] for the manufacture of the optical bridge, or for its installation on the Stereocomparator. STAT

It has thus become necessary for [ ] to hand-scrape the mounting surfaces of the Stereocomparator to properly accommodate the optical bridge parts when they are returned by [ ] STAT

The type of situation that is creating a problem is the fact that [ ] is required to maintain the alignment of the optical axis through the objective lenses to 1/4 micrometer during the change of position. STAT

required for the focussing accommodation.

Aligning the large parts of the optical bridge to a perpendicularity of the order of 30 seconds presents a considerable mechanical problem.

#### PRE ACCEPTANCE TESTING

The testing philosophy that is presently being developed with [ ] is based on performing acceptance type tests on subassembly STAT while they are installed in the optical laboratory.

This will determine the inherent performance capability of the individual items at the earliest possible time in the program, and also in a situation where parts are readily accessible for adjustment or rework. This does have the effect of adding somewhat to the work effort, but it is felt that much time will be saved later, during the formal acceptance test effort.

A great deal of thought is presently being given, both at [ ] STAT [ ] with respect to the acceptance testing at [ ] STAT

#### RESOLUTION TARGETS

[ ] was provided with the latest film resolution targets STAT prepared by our customer. These targets were reviewed very carefully by [ ] using the highest quality microscope equipment. STAT

It was agreed that the targets were acceptable to [ ] in STAT terms of their quality. The quality was seen to be excellent under approximately a 600 power magnification.

In addition, the targets were examined using microscope apertures and magnifications equivalent to that present in the Stereo-comparator. No unusual problem is anticipated using the targets.

#### RESOLUTION TEST

[ ] is planning how to determine resolution through the assembled Stereocomparator optical system. They have decided to use a telescope arrangement at the eyepieces to examine the aerial image of the resolution target. STAT

By this means, there should be a minimum amount of controversy caused by possible differences in the observers and the viewing arrangement.

The telescope to be provided by [ ] will be of the order of 2X to 4X magnification. STAT

It is proposed to use a 0.25 millimeter pupil at the telescope eyepiece when using the 4X telescope. This would, for example, at 4X change the arc subtended at the eye from 2 minutes to 8 minutes, thus materially improving the visibility of the target.

#### ZOOM TEST

The bench test and the acceptance test for the zoom system was discussed. These tests covered two parameters:

- a. Image wander during magnification change.
- b. Range of magnification change.
- c. Distortion.
- d. Resolution.

In the bench test, the image wander would be determined using a 0.2 second of arc auto-collimator during change of magnification.

In the acceptance tests, the image wander during zooming would be established by means of a special eyepiece scale carrying a series of concentric circles.

For acceptance tests, the magnification would be determined by the super-positioning of an eyepiece scale with a target scale. A grid target covering the range of 10X to 320X in 2X progressive steps would appear to be satisfactory.

These targets would require standardization to an accuracy of about 1 micrometer.

The eyepiece scale would require resolution of the scale to within plus or minus 0.5% of the scale length.

The magnification would have to be established in both X and Y directions for the full range of the zoom. These values would be plotted against the potentiometer readout. In addition, it will be necessary to establish and plot the magnification change with the zoom can position.

For both bench and acceptance testing, the tests would include determination of the parameters on the optical axis, at 1/3 of the field radius, and at the edge of the field. Values would be determined representing the sagittal and tangential directions.

#### OBJECTIVE LENS IMAGE WANDER

is planning to use their 0.2 seconds of arc auto-collimating system in a suitable bench test for preacceptance testing of

STAT

the amount of image wander during the focussing adjustment of the objective lenses.

#### ANAMORPH TEST

The anamorph system would be bench tested for image wander, distortion, anamorphic expansion range, azimuth angle and resolution.

The acceptance test would be essentially the same except that items such as resolution cannot be determined for the anamorphic subassembly alone, since the overall resolution becomes a characteristic of the entire optical system.

The anamorphic ratio would be tested by means of an anamorphic ratio grid target in the field of view, and a similar eyepiece grid. Superpositioning the two targets would determine the numerical value of the parameter.

As with the zoom system, it will be necessary to establish the voltage output of the potentiometer with respect to the anamorphic ratio, as well as the angle of the cam drive with respect to the anamorphic ratio.

The anamorphic ratios would be tested at values of 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0.

Acceptance tests would be made using the objective lens  $F = 40$  millimeters at magnifications of 20X, 100X and 200X. Also using the objective lens  $F = 80$  millimeters, the acceptance tests would be made at magnifications of 10X, 50<sup>A</sup>X and 100X.

The tests would be performed by rotating the stage, (thus the target), and correcting the upset conditions by an appropriate anamorphic rotation.

The anamorphic rotation azimuth angle would be determined using the field grid and an eyepiece angular measure reticle. When the field grid is rotated, the angle of rotation can be measured directly at the eyepiece.

Note that the potentiometer output and cam angle must be measured and compared with the anamorph parameters.

The image wander for the acceptance test would be determined by using the eyepiece reticle consisting of concentric circles.

#### PECHAN TEST

The testing of the Pechan prism assembly will utilize the line target and the angular eyepiece reticle used for the anamorph testing.

The potentiometer output voltage and the drive shaft angle would be plotted against eyepiece reticle angular position.

The image wander would be checked using the concentric circle eyepiece reticle.

#### EYEPIECE SWITCHING TEST

The switching assembly and the eyepiece geometry will require testing for inter-pupillary distance range, convergence angle range and alignment during switching.

Stability of the eyepiece system during switching, including image wander caused by the change of focus or the eyepiece geometric parameters can be determined by the concentric circle eyepiece reticle and using the main illuminated spot reticle.

## FOCUS TEST

A further test of the Stereocomparator system would be the requirement that it maintain focus during all elementary movements of the various subsystems.

The variation of focus should be less than the accommodation range of the eye, plus or minus 1 diopter.

An eyepiece telescope would be used for system viewing.

## RETICLE PROJECTOR TESTS

The reticle spot projector system will require a complete series of tests paralleling those of the main optical system. The specifications of the reticle spot projector are, of course, not as stringent as those for the main viewing optical system. For example, there would be no resolution target requirement.

The primary parameter of concern would appear to be image wander caused by movement of the various elements of the reticle projection system.

## FILTER CALIBRATION

The light filter wheels of variable density would require calibration and testing. There are six pairs of neutral density filter wheels in the Stereocomparator system.

There is a probability that  will use photoelectric systems to calibrate the filter wheels. This could be done relatively easily for the main illumination system and the eyepiece system. However, in the case of the reticle spot system, the illuminated area is so small

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that the photoelectric pick-up system would not be sufficiently sensitive.

It was suggested that this situation might be solved by considering the reticle spot as if it were a spot photometer. The surrounding field level of illumination would be adjusted, after calibration, so that the reticle spot would appear to blend into the background, thus being of equal intensity with the background. Since the background illumination level could be at a known brightness, it should be possible to calibrate the reticle spot filter system from this information.

This problem was only discussed and not worked out with any detail. The density checkpoints of the main illumination system would appear to be 0.5, 0.75, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0. The eyepiece filter wheel would be calibrated at 0.2, 0.4, and 0.6 density.

The shaft angle and potentiometer output would be calibrated against density.

#### LIGHT LEVEL TESTS

In addition to the foregoing tests, it will also be necessary for  to determine the absolute light level reaching the eyepieces, STAT and additionally, the absolute light level and the ratio of the light distributed between the image dissector tubes, the light level control photo-multiplier tubes and the eyepieces.

No decision has yet been reached as to exactly how this test would be performed.

It should be reiterated that completeness of bench testing and

realization of acceptable parameters for every sub-assembly of the Stereocomparator is considered to be of the most critical importance.

#### OPTICAL BRIDGE WIRING

Because of the delicate nature of the installation, and the crowded situation in the optical bridge after assembly of the optical system, it will be necessary for [ ] to mount the plug receptacles and install the wiring at the time they are making the optical subassemblies. STAT

There is a considerable quantity of wiring between the electrical components such as potentiometers, motors and microswitches and their respective receptacles. [ ] will have to specify these wiring requirements for [ ] as soon as possible. STAT

Further, it will be necessary for [ ] to install the electronic cables (supplied by [ ] in the optical bridge. These cables will require mounting with clips which, in turn, will require some drilling and tapping of the various mechanical parts. This sort of work should not be carried on after completion of the installation of the optical subassemblies, and [ ] must therefore be provided with the cable routing so that the work can be performed during assembly of the optical subassemblies in the optical bridge. STAT

#### TEST EQUIPMENT AND INSTRUMENTS

[ ] will require certain special test facilities from [ ] STAT  
For example, a set of plugs for the back of the optical bridge to match all the receptacles situated therein. The plugs must be wired to a convenient distance and terminated in appropriate barrier strips. These will

have to be made by [ ] and shipped to [ ]

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[ ] must also ship the illumination system power supplies and starters, servo power supplies and other power supplies required in conjunction with potentiometer outputs and microswitch actuation.

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[ ] will also have to provide [ ] with any test instrumentation such as digital volt meters and the test targets described earlier.

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#### REVIEW AND MONITORING SCHEDULE

As the [ ] contract proceeds towards its final stages, many interface problems and requirements develop that can only be solved in a timely manner by frequent in-depth reviews and careful monitoring of the program.

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With these factors in mind, a tentative review schedule has been developed with [ ] This schedule interfaces with the [ ] subassembly optical bench testing and the development of test procedures, and final assembly in the [ ] optical bridge. The objective is to pave the way for the earliest possible and successful acceptance testing program.

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The following schedule is based on the presently projected [ ] manufacturing schedule.

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[ ] MONITORING AT [ ]

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- A. April 14-18, 1969. Manufacturing schedule and progress review.  
 Trial installation of the [ ] optical bridge in the [ ] test fixture. STAT  
 Use of [ ] installation tooling. Access and use of test targets in STAT  
 [ ] test fixture. Test program requirements and discussion of STAT  
 test procedures.
- B. June 16-20, 1969. Review and optical bench testing of first assemblies  
 completed by [ ] Review of test procedures. Review of electronic STAT  
 interface and electronic requirements for testing. This will require the  
 presence of an [ ] electronic engineer at [ ] in addition to the STAT  
 regular manufacturing review and project monitoring effort.
- C. Aug. 11-22, 1969. Completion of subassemblies and optical bench testing.  
 Installation of optical subassemblies in the optical bridge. Installation of  
 optical bridge on the [ ] test fixture. Final review of optical acceptaSTAT  
 test procedures.
- D. Sept. 15-26, 1969. Completion of final assembly by [ ] Review of STAT  
 performance parameters obtained to date by [ ] during optical bench STAT  
 checkout. Final approval of acceptance test procedures. Review of  
 acceptance test arrangements. Review of rework proposals by [ ] STAT  
 if and as necessary. Final directions to [ ] regarding electronic STAT  
 interface installations by [ ] STAT
- E. Oct. 20-31, 1969. Review and approval of bench performance parameters.  
 Final review of acceptance test arrangements. Decision to proceed with  
 final acceptance test schedule. Checkout of all equipment and facilities  
 for performance of final acceptance test. Depending on the circumstances,  
 in addition to the program monitor, an [ ] electronic technician might be STAT  
 required during part of this time.
- F. Nov. 3-28, 1969. Final adjustment of optics and performance of  
 acceptance test. The [ ] personnel present during this period would STAT  
 include, in addition to the program monitor, an [ ] electronic engineer, STAT  
 the test program director, and, depending on the circumstances, a mechanical  
 engineer and an optical consultant.

The foregoing program outline is based on the best information presently available. This schedule should not be considered optimistic, and while a delay may arise, there is every expectation that the schedule can be met.

[redacted]

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The [redacted] monitor visited the [redacted] plant which is about 100 kilometers southeast of Paris.

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The plant was clean and well arranged, and was impressively large. There were approximately 450 employees presently employed.

The facilities included a large machine shop with a substantial percentage of automatic screw machines and other automatically controlled machine tools. There were several jig borers.

None of the machine tools was very large, that is, they were making parts that one would normally associate with usual optical systems. There were perhaps 100 major machine tools with turning, grinding, milling, boring, drilling, shaping and gear cutting capability.

In addition to the machine shop, there was a large optical manufacturing facility with possibly 200 glass grinding and polishing stations. A substantial portion of the work was noted to be complex prisms, this in addition to lenses of all sizes and types.

There were about six clean room assembly areas containing approximately 30 employees each.

Four large hydraulic test stands with dynamometers were noted for calibrating and testing hydraulic pumps and motors. The maximum horsepower was about 500, and the maximum pressure was about 10,000 pounds per sq. inch.

The factory had been building a high quality camera, similar to the Leica, called a Foca, but this had been discontinued some months ago because of inability to compete with pricing of Japanese cameras.

The plant, as a whole, was well kept up and appeared to be busy. The production control department had about 20 employees. There were many inspection activities in progress throughout the optical fabrication shops.

The plant was building hydraulic valves, hydraulic servo valves, hydraulic motors, hydraulic pumps, optical refractometer instruments, rifle telescopes, optical range finders, submarine periscope optics, and small lot optic job fabrications in lots of 25 to 200.

In addition, the plant generally supports the various [ ] activities of the other three [ ] facilities. STAT  
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SUBASSEMBLIES MADE AT [ ] STAT

Six of the [ ] subassemblies were identified at the [ ] plant. These consist of [ ] items as follows: STAT  
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- 90 - Main Optics Image Rotator
- 120 - Eye Piece Assembly
- 220 - Reticle Spot Image Rotator
- 270 - Reticle Spot Illumination System
- 330 - Filter Wheels for Light Adjustment
- 350 - Condenser and Light Source

## SUMMARY

The conclusion of this review trip was that [ ] is proceeding satisfactorily according to its latest schedule with only one troublesome area detected. Namely, the coating operation for the FK50 glass. STAT

[ ] has found it necessary to remove the coatings and re-polish the glass which had become slightly pitted during the coating operation. [ ] is very concerned over this problem, and yet does not feel that there is a real crisis since prior to production coating, samples of the glass were sent through the coating operation without any difficulty. STAT

[ ] feeling is that there is an aberration in the process which can be readily determined and corrected, and there is no basic setback involved. STAT

This matter is of significance since [ ] in December 1968 warned [ ] that this particular glass might present problems during coating and fabricating in general. STAT

At this February 1969 visit, [ ] had only just realized that there was a problem, and there was no immediate solution presented except to strip the lenses, re-polish, and send them through the coating operation again under more carefully controlled conditions. STAT

APP. II

PROGRESS REPORT FOR PERIOD ENDING 31 JANUARY 1969

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1.0 Progress During Reporting Period

Layout modifications continued on the image dissector assembly. The dynode regulator board, the video amplifier board and the deflection amplifier board layouts were completed and purchase orders placed on the materials for these boards. Internal wiring was reduced to a wire list, which was completed during this period. The top assembly layout was also in progress during this period.

Work also progressed on the chassis assembly. Chassis wiring will be done as point to point wiring from the interwiring drawing. Top assembly layouts were in checking at the end of January.

Existing cable drawings were updated and in checking at the end of this period.

Test fixture drawings and holder modifications had also progressed to the checking stage.

New starts consist of modification to the multiplier module layouts and the channel selector schematics. The latter was modified to reflect updated information and to use  $\mu$ A741 modules to simplify the circuitry. The channel selector layout work will be purchased from an outside vendor.

Overall progress to the end of this reporting period is approximately 45%, excluding considerations resulting from customer contacts.

2.0 Plans for Next Period

In-house layouts and procurements of outside layout work are expected to be completed in February.

Assembly of printed circuit boards and component boards will be under way as procurement cycles are completed.

3.0 Topics During [ ] Visit

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On January 21, [ ] led the discussion for [ ] Released prints on the time base generator, the sum and difference assembly, the extender board, the modulator module, modulator assembly, and schematics of the integrator, raster delay and image dissector assembly were discussed and later forwarded to the customer. The [ ] representatives requested and took with them preliminary prints on the Image Dissector Assembly Layout, the Chassis Layout, the Interface Connector on the interwiring diagram and the Test Fixture Layout including views of the holder.

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A description of the test fixture and holder was given by [ ]

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The content of the test slides was discussed. Several slides were shown by [ ] After viewing them with the enlarger, sections of certain slides were thought to have agreeable material. These sections will be reprocessed and sent to [ ] to confirm agreement before the test distortions are introduced.

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A telegram from [ ] was received on February 3. Phone conversations with [ ] on the 4th, 5th, and 6th of February revealed some dissatisfaction with the holder assembly, the power connector, the cabling and the slides. The existence of a  $\frac{1}{4}$  inch bulkhead, which interrupts the cabling was brought up. An inability to communicate this information at the completion of the preceeding study contract [ ] was cited as the reason for the late advisory. Corrective action is expected to result in additional slippage to the schedule.

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APP. III

## MONTHLY PROGRESS REPORT

January, 1969

This technical report is for the reporting period from January 1 to January 31, 1969. The report is prepared according to

(as modified).

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1. During this month a substantial portion of the non-real time system has been completely defined and some procedures respecified. The examination of these respecified and detailed procedures has accounted for most of the effort this month.

The respecifications have consisted of modifications to the model to increase the attainable accuracy in the system and in some instances a detailed specification of parameters and subprocedures in the model which were initially stated only generally. In order to increase the accuracy of the system, new procedures have been created and old procedures have been modified (e.g., T2STRIP, XAI, CAMATS).

The revisions have resulted in the generation of new flowcharts and descriptions of methods and required parameters.

New flowcharts for the following subprograms have been generated this month and have been submitted independently of this report:

- a. DATAIN
- b. PTOP
- c. SCANNER
- d. CONVU
- e. REORT
- f. MTS
- g. CAMATS
- h. XAI
- i. T2PAN
- j. T2STRIP

The subprograms of the final system which have been coded this month are:

- a. REORT
- b. MTS
- c. CAMATS
- d. XAI
- e. T2PAN
- f. T2STRIP

A concentrated effort was made to evaluate an alternate method of processing correlator corrections in the real time program and these results are described below in proposed changes.

Approximately 45% of the total work has been completed as of this reporting period.

2. Next month all of the remaining subprograms in the non-real time portion of the final system will be flowcharted and coded. Most of these routines will be completely debugged and incorporated into a subsystem.

Work will begin on the final system creation including storage layouts for subprograms and common areas, program linkage methods and minimizing cross sector references.

The final system will be debugged by creating several subsystems and debugging these independently. This process will begin next month with preparations for the final work to be done early in the following month.

A sample of the final proposed format for the computer programming system documentation will be submitted for approval.

Work will begin on the first draft of the test procedures for the final system and will include procedures for both the simulation mode and the final operating system. The first draft of the test procedures should be submitted around the end of next month.

3. At this time there exist no pending or unresolved technical problems.
4. There are no pending, unresolved contractual problems.

5. It was orally agreed that the input parameters to the system would be converted using a FORTRAN method. This method of conversion implies that only the seven most precise decimal digits would be converted to floating point. This precision will be further reduced after the conversion from floating point to fixed point, but the maximum precision possible will always be maintained.

The precision of all fixed point quantities will ultimately be modified in the real time subsystem after all the ranges of the parameter values have been determined.

The outline of the orally agreed upon format of the sub-program documentation is as follows:

- a. General discussion contained in opening paragraphs.
- b. Calling Sequence.
- c. Required Data.
- d. Output Data.
- e. Subroutines Called.
- f. Called By.
- g. Method.

The general discussion will contain a short description of the mathematical model including all the required formulas as given in the program specifications. The same notational conventions will be employed here as were initially used in the specification with added examples and explanations where needed.

The remaining items describe the actual computer programming techniques employed and are easily related to items in the general discussion.

It is felt that this method of documentation will facilitate verifying that the procedures correspond to the specifications.

Variable names used in the coding of the computer programs are being generated using the following conventions:

- a. Where Greek letters are involved, the variable names are either the euphonic English spelling of the Greek letter or a shortened version thereof, (e.g.,  $\eta$ -eta), a spelling of the corresponding physical parameter, (e.g.,  $\nu$ -heading or HED), or constructed using the following correspondence:

Greek	English
$\alpha$	L
$\beta$	V
$\tau$	T
$\mu$	U
$\nu$	Nu

- b. All variables with superscripts and/or subscripts in the model descriptions are assigned names made up of the variable letter followed by the superscript and then the subscript.

E.g.,  $C_a^j$  - CJL,  $C_a^\beta$  - CVL

## 6. No Camera Data

The "No Camera Data" case has been specified and is currently being implemented. There is no change in the non-real time subsystem and a minor change in the real time program TRK which is indicated by this specification. A brief description of the specification is contained in the following paragraphs.

If stereo fusion is attained on two conjugate points on a pair of stereo films, the optical transfer functions for the slave ( $X_r^j$ ) and master ( $X_m^j$ ) optics are completely defined as a function of the optical settings and not as a function of camera data. The transformations map vectors from the stage to the image coordinate systems.

With camera data it is possible to generate a third transformation ( $X_m^r$ ) which takes vectors from the master to slave photo coordinate system.

Master stage motion is generated by transforming motion indicated in the image by  $(X_m^j)^{-1}$ . Now, if camera data is available, we convert master stage motion to slave stage motion using  $X_m^r$ . Without camera data,  $X_m^r$  is not available and we determine slave stage motion directly with  $X_r^j$ .

### Correlator Correction Processing

A "preferred" (direct) method of processing correlator correction signals has been suggested by [ ] and has been verified to everyone's satisfaction. This change will be implemented next month and made a part of the final system.

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The following paragraphs briefly describe the original and "preferred" methods and give storage and timing estimates for each.

The original method very simply stated consisted of reading the correlator values and operating on the values with a matrix of partial derivatives generated in non-real time. This operation converted these corrections to new settings of the optical elements. The total time required for this method is about 150 microseconds in real time once every four real time cycles.

The new "preferred" method consists of operating on the optical transfer function of the slave optics with the read correlator values directly and calculating new optical settings which are a function of the instantaneous correlator corrections. This new method requires about 840  $\mu$ s, about a 550% increase.

The main routine in the real time subsystem TRK averages about 700  $\mu$ s execution time for all logic and outputs regardless of the correlator processing method used. Every four real time cycles, the total time required is 2950  $\mu$ s ( $4 * 700 + 150$ ) for the "old" method and 3640  $\mu$ s ( $2800 + 840$ ) for the direct method. This amounts to about a 12% increase in the real time used every four cycles.

To compare these figures to the original timing estimates in the specifications, we now have about 88% of cycle time available for background processing. This apparent increase is because of the improvement over the estimates in execution time.

Implementing this new method involves a major modification of the non-real time procedure TMAT, and the real time procedure RDCR. The changes to TMAT include the elimination of the calculations of the matrix of the partial derivatives of the optical settings with respect to the Optics Transformation Matrix for the slave stage.

The real time subsystem is modified by eliminating the calculation of "delta correlator values" and the transformation of these values to new optical settings. These calculations have been replaced by operating on the slave optical transfer function with the matrix of correlator readings and converting this resultant transfer function to optical settings.

Although no exact figures are available, the difference in storage requirements can be estimated as a substantial savings with the new method since we are eliminating many FORTRAN statements and adding a few machine language instructions. This should save about 300-400 storage cells.

Since the subprograms affected by this change - TMAT and RDCR - have not been coded, we feel that this implementation will not amount to a change of scope of the contract.

#### New Procedures

Four new subprograms have been proposed and are under consideration. Their proposed names and functions are:

- a. RDCRX - Input the correlator corrections of x, y displacements.
- b. T2STRIP - Iterative solution of the time of exposure for strip type slave photograph.
- c. XAI - Computes the camera station location in ground coordinates and the ground to photo transformations  $C_a^a$  and  $C_\sigma^a$ .
- d. PSET - A Dap routine called by REORT which initializes the photo settings for tracking.

Changes to the subprogram TMAT are being considered which will include an iterative derivation of a ground tangent plane as a function of the earth's curvature.

7. No other unresolved matters are known to exist.